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Indian Standard
METHODS OF SAMPLING AND PHYSICAL
TESTS FOR REFRACTORY MATERIALS
PART XIV DETERMINATION OF SIEVE ANALYSIS
(*First Revision*)

Second Reprint SEPTEMBER 1991

UDC 666.76:621.928.2

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard
**METHODS OF SAMPLING AND PHYSICAL
TESTS FOR REFRACTORY MATERIALS**
PART XIV DETERMINATION OF SIEVE ANALYSIS
(First Revision)

Refractories Sectional Committee, SMDC 18

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SHRI J. C. BANERJEE
107 C.I.T. Road, Belegghata
Calcutta 700010

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Indian Standard

METHODS OF SAMPLING AND PHYSICAL TESTS FOR REFRACTORY MATERIALS

PART XIV DETERMINATION OF SIEVE ANALYSIS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part XIV) (First Revision) was adopted by the Indian Standards Institution on 10 July 1974, after the draft finalized by the Refractories Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 Methods of sampling and physical tests for refractory materials were originally covered in IS : 485-1953 'Methods of sampling and testing of refractory materials (*tentative*)'. This Indian Standard was first published in 1962 on methods of sampling and physical testing of refractory materials. As a result of experience gained during these years, certain modifications have been made in the methods of sampling, methods of physical test and the method for the determination of the warpage in refractory materials. The Sectional Committee while issuing this revision felt it desirable to issue the standard in separate parts.

Other parts of this standard published so far, cover the following :

- Part I Determination of pyrometric cone equivalent (PCE) or softening point
- Part II Determination of refractoriness under load
- Part III Determination of spalling resistance
- Part IV Determination of cold crushing strength
- Part V Determination of modulus of rupture
- Part VI Determination of permanent change after reheating
- Part VII Methods of sampling and criteria for conformity
- Part VIII Determination of apparent porosity
- Part IX Determination of true specific gravity and true density
- Part X Determination of size of refractory bricks
- Part XI Determination of warpage
- Part XII Determination of bulk density
- Part XIII Determination of resistance to the disintegrating effect of carbon monoxide

0.3 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part XIV) prescribes the method of test for determination of sieve analysis.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 4041-1967† shall apply.

3. SIEVE ANALYSIS

3.0 **Object of Test** — This test covers both wet and dry sieve analysis of refractory materials.

3.0.1 *Wet Sieve Analysis* — As water promotes the slaking of clays and helps to separate fine particles and wash them from the larger grains, wet sieve analysis provides more reliable information than the dry method on materials to which water is added and in which slaking would occur in normal industrial use. This method is, therefore, recommended for use with such materials.

3.0.2 *Dry Sieve Analysis* — The dry method is not as effective as the wet method in determining the amount of material present in the smaller particle sizes. It is recommended for any non-plastic material, namely:

- a) clays, only when the slaking action of water is undesirable;
- b) when the clay is to be used in such a way that the size of the ultimate particles is of secondary importance; and
- c) when the material is in the form of coarsely ground grog and calcined.

3.0.3 *Water Content* — A method for determining the water content of air-dried samples as received is also included so that the sieve analysis can be calculated on the dry basis.

3.1 Water Content

3.1.1 *Wet Type Air-Setting Refractory Mortars* — Sample the material immediately after opening the original container and after carefully mixing the contents. Weigh approximately 50 g of the test samples. To facilitate handling the test sample, it is recommended that it should be placed on a tared piece of waxed paper or tared aluminium weighing dish. Determine

*Rules for rounding off numerical values (revised).

†Glossary of terms relating to refractory materials.

the exact mass of the test sample to the nearest 0.1 g both before and after drying for 24 hours at 105 to 110°C. Calculate the percentage of water on the as-received basis to the nearest 0.1 percent.

3.1.2 Materials Other Than Wet Type Air-Setting Refractory Mortars (such as Ground Fireclays, Fireclay Mortars, Dry-Type Air-Setting Mortars, Plastic Refractories and Similar Materials) — If the material is shipped in the wet condition, take care to see that no loss of water occurs before the test sample is taken. Weigh approximately 250 g of the test sample. Determine the exact mass of the test sample to the nearest 0.1 g both before and after drying for 3 hours at 105 to 110°C. Calculate the percentage of water on the as-received basis to the nearest 0.1 percent.

3.2 Wet Sieve Analysis

3.2.1 Dry Materials — If the material is received in the dry condition, take the test sample (see Note 1) out of the dried and weighed material prepared in accordance with 3.2.2.

3.2.2 Wet Materials — Test materials prepared with water (plastic refractories), wet type high temperature bonding mortars, etc, shall be tested as received. Take two test samples immediately after opening the original container, and in the case of mortars, after carefully mixing the contents. Use one sample for obtaining the water content in accordance with 3.1.1 and 3.1.2 depending upon the type of material. Use the other sample (see Note 1), weighing approximately 250 g, for the sieve analysis. Weigh the sample to the nearest 0.1 g and then transfer it to a one-litre container (see 3.2.3). Wash the utensils used during weighing (to which a small part of the sample may adhere) by means of a small jet of water from a 5-mm hose in such a manner as to ensure a quantitative transfer of the weighed sample to the container.

3.2.3 Procedure — Place the test sample in a container of about one litre capacity, to which add sufficient water to form a slurry. Allow slaking to proceed for one hour after which add a further quantity of water if necessary. Then transfer the test sample without loss to the finest sieve to be used in the analysis, and then wash by means of a small jet of water from a 5-mm rubber hose until the water passing through the sieve contains only traces of the sample. Exercise care in the washing operation to prevent loss by splashing. If necessary, break up lumpy material by gentle rubbing or pressing against the sieves. Then dry the washed residue in the sieve to constant mass at 105 to 110°C. This usually requires about 2 hours. If desired, use a preliminary drying period at a lower temperature. Then transfer the dried residue to the top or coarsest sieve of the series to be used, complete the sieving and weighing operations in accordance with 3.3.1 and 3.3.2.

3.2.4 Calculation and Report — Calculate the wet sieve analysis for the test sample on the dry mass and report the results to the nearest 0.1 percent of the material retained on each sieve (see Note 2). Report the percentage passing the finest sieve as the difference between 100 percent and the sum of the percentages retained on the various sieves.

3.3 Dry Sieve Analysis

3.3.1 Machine Sieving — When doing the sieving by machine, arrange the sieve in the order of size with the coarsest sieve at the top of the nest. Take the sample for sieving (*see* Note 1) out of the dried and weighed material prepared in accordance with **3.1.2**. Transfer it to the top sieve of the nest, and then subject it to the mechanical sieving operation until less than 0.1 g of the material passes through each sieve after 1 minute of sieving by hand, as described under **3.3.2**. The machine sieving operation usually requires about 15 minutes. Then carefully separate the sieves and determine the amount of material retained on each sieve by weighing to the nearest 0.1 g.

3.3.2 Hand Sieving — Take the sample for sieving (*see* Note 1) out of the dried and weighed material prepared in accordance with **3.1.2**. Carry out the sieving operation using one sieve at a time beginning with the coarsest sieve and from then on using successively finer sieve sizes. Alternatively tap and rotate the sieve, with pan and cover attached while holding it in a slightly inclined position so that the test sample is well distributed over the sieve. Continue the operation until less than 0.1 g of the material passes through each sieve in one minute of continuous sieving. Determine the amount of material retained on each sieve by weighing to the nearest 0.1 g.

3.3.3 Calculation and Report — Calculate the dry sieve analysis for the test sample, on the dry mass, and report the results to the nearest 0.1 percent of the material retained on each sieve (*see* Note 2). Report dust loss as material passing the finest sieve.

NOTE 1 — Change the size of the test sample, if necessary, by reason of the nature of the material. For example, some clays, when ground to exceedingly fine particle size, tend to pack or cake on the sieves, in which case use a 100 g sample. In the case of plastic refractories, or coarsely ground mixes, increase the size of the sample to 500 g in mass.

NOTE 2 — As an alternative, report the results of sieve analysis on the cumulative basis, either as the total percentage retained on or passing each sieve.

4. SAMPLING AND CRITERIA FOR CONFORMITY

4.1 The procedure for sampling and the criteria for conformity shall be as laid down in IS : 1528 (Part VII)-1974*.

*Methods of sampling and physical tests for refractory materials: Part VII Methods of sampling and criteria for conformity (*first revision*).

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Refractories Investigations Subcommittee, SMDC 18 : 3

Convener

SHRI J. C. BANERJEE
107 C.I.T. Road, Belegkata
Calcutta 700010

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NEW DELHI 110002

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{ 38 49 55
{ 38 49 56

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5 36 27
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{ 6 98 32

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{ 21 68 76
{ 21 82 92

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